

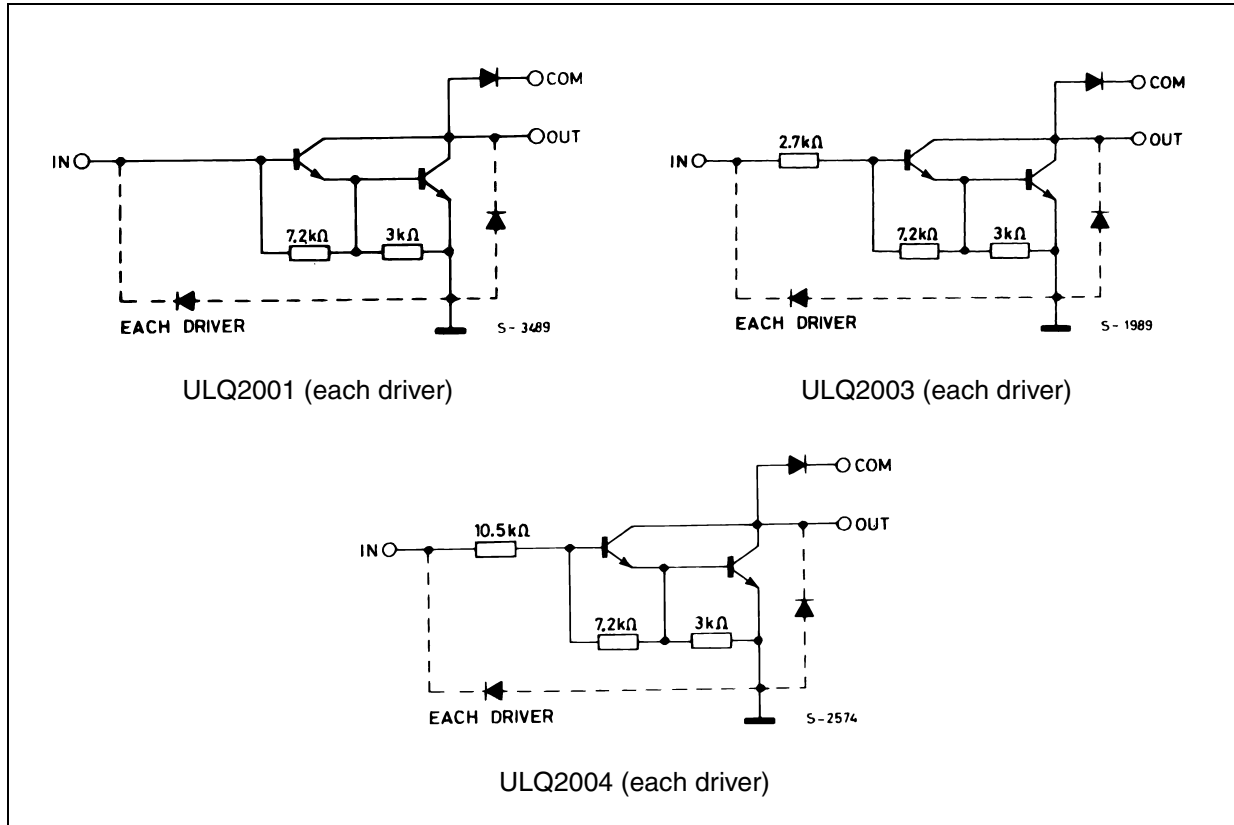
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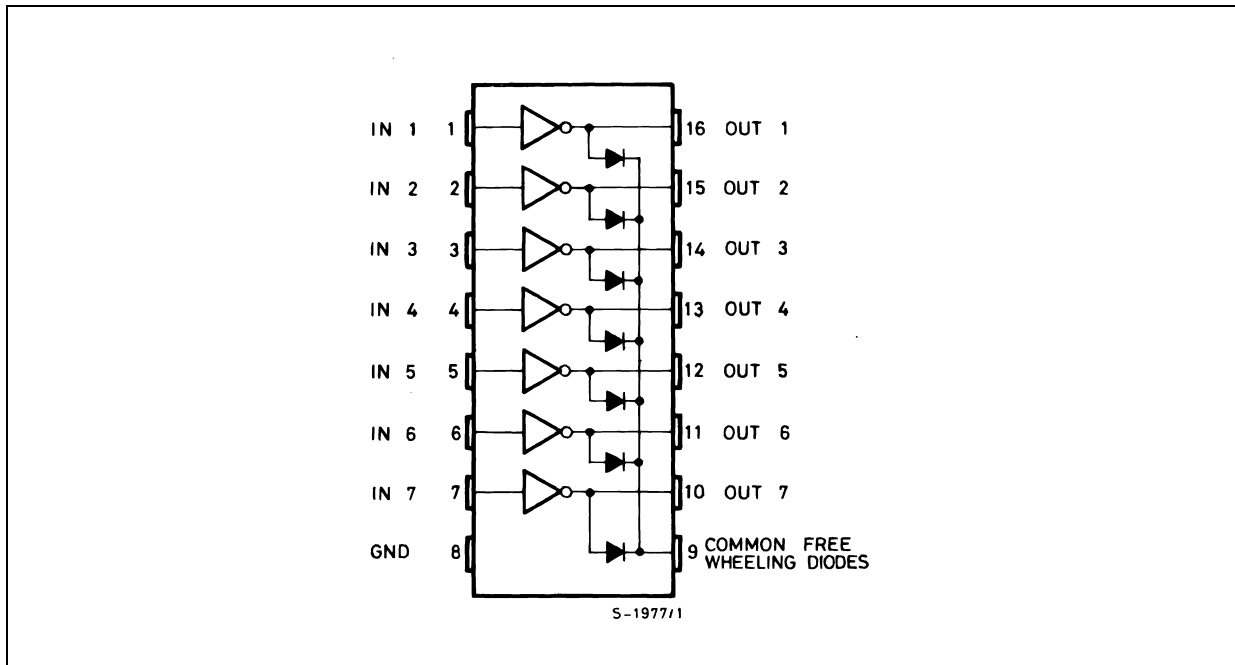
# 1 Diagram

Figure 1. Schematic diagram



## 2 Pin configuration

Figure 2. Pin connections (top view)



### 3 Maximum ratings

**Table 2. Absolute maximum ratings**

Symbol	Parameter	Value	Unit
$V_O$	Output voltage	50	V
$V_{IN}$	Input voltage (for ULQ2003A/D1 - 2004A/D1)	30	V
$I_C$	Continuous collector current	500	mA
$I_B$	Continuous base current	25	mA
$T_A$	Operating ambient temperature range	-40 to 105	°C
$T_{STG}$	Storage temperature range	-55 to 150	°C
$T_J$	Junction temperature	150	°C

**Table 3. Thermal data**

Symbol	Parameter	DIP-16	SO16	Unit
$R_{thJA}$	Thermal resistance junction-ambient, max.	70	120	°C/W

## 4 Electrical characteristics

$T_J = -40$  to  $105$  °C for DIP16 unless otherwise specified,  
 $T_J = -25$  to  $105$  °C for SO16 unless otherwise specified.

**Table 4. Electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$I_{CEX}$	Output leakage current	$V_{CE} = 50V$ , (Figure 3)			50	$\mu A$
		$T_J = 105^\circ C$ , $V_{CE} = 50V$ (Figure 3)			100	
		$T_J = 105^\circ C$ for ULQ2004, $V_{CE} = 50V$ , $V_I = 1V$ (Figure 4)			500	
$V_{CE(SAT)}$	Collector-emitter saturation voltage (Figure 5)	$I_C = 100mA$ , $I_B = 250\mu A$		0.9	1.1	V
		$I_C = 200mA$ , $I_B = 350\mu A$		1.1	1.3	
		$I_C = 350mA$ , $I_B = 500\mu A$		1.3	1.6	
$I_{I(ON)}$	Input current (Figure 6)	for ULQ2003, $V_I = 3.85V$		0.93	1.35	mA
		for ULQ2004, $V_I = 5V$		0.35	0.5	
		for ULQ2004, $V_I = 12V$		1	1.45	
$I_{I(OFF)}$	Input current (Figure 7)	$T_J = 105^\circ C$ , $I_C = 500\mu A$	50	65		$\mu A$
$V_{I(ON)}$	Input voltage (Figure 8)	for ULQ2003			2.4	V
		$V_{CE} = 2V$ , $I_C = 200mA$			2.7	
		$V_{CE} = 2V$ , $I_C = 250mA$			3	
		$V_{CE} = 2V$ , $I_C = 300mA$			3	
		for ULQ2004			5	
		$V_{CE} = 2V$ , $I_C = 125mA$			6	
		$V_{CE} = 2V$ , $I_C = 200mA$			7	
$V_{CE} = 2V$ , $I_C = 275mA$			8			
$V_{CE} = 2V$ , $I_C = 350mA$			8			
$h_{FE}$	DC forward current gain (Figure 5)	for ULQ2001, $V_{CE} = 2V$ , $I_C = 350mA$	1000			
$C_I$	Input capacitance			15	25 <sup>(1)</sup>	pF
$t_{PLH}$	Turn-on delay time	$0.5 V_I$ to $0.5 V_O$		0.25	1 <sup>(1)</sup>	$\mu s$
$t_{PHL}$	Turn-off delay time	$0.5 V_I$ to $0.5 V_O$		0.25	1 <sup>(1)</sup>	$\mu s$
$I_R$	Clamp diode leakage current (Figure 9)	$V_R = 50V$			50	$\mu A$
		$T_J = 105^\circ C$ , $V_R = 50V$			100	
$V_F$	Clamp diode forward voltage (Figure 10)	$I_F = 350mA$		1.7	2	V

1. Guaranteed by design.

T<sub>J</sub> = -40 to 125 °C for SO16 unless otherwise specified.

**Table 5. Electrical characteristics for ULQ2003D1013TRY (Automotive Grade)**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
I <sub>CEX</sub>	Output leakage current ( <a href="#">Figure 3</a> )	V <sub>CE</sub> = 50V			50	μA
V <sub>CE(SAT)</sub>	Collector-emitter saturation voltage ( <a href="#">Figure 5</a> )	I <sub>C</sub> = 100mA, I <sub>B</sub> = 250μA		0.9	1.1	V
		I <sub>C</sub> = 200mA, I <sub>B</sub> = 350μA		1.1	1.3	
		I <sub>C</sub> = 350mA, I <sub>B</sub> = 500μA		1.3	1.6	
I <sub>I(ON)</sub>	Input current ( <a href="#">Figure 6</a> )	V <sub>I</sub> = 3.85V		0.93	1.35	mA
I <sub>I(OFF)</sub>	Input current ( <a href="#">Figure 7</a> )	I <sub>C</sub> = 500μA	50	65		μA
V <sub>I(ON)</sub>	Input voltage ( <a href="#">Figure 8</a> )	V <sub>CE</sub> = 2V, I <sub>C</sub> = 200mA V <sub>CE</sub> = 2V, I <sub>C</sub> = 250mA V <sub>CE</sub> = 2V, I <sub>C</sub> = 300mA			2.4 2.7 3	V
C <sub>I</sub>	Input capacitance			15	25	pF
t <sub>PLH</sub>	Turn-on delay time	0.5 V <sub>I</sub> to 0.5V <sub>O</sub>		0.25	1	μs
t <sub>PHL</sub>	Turn-off delay time	0.5 V <sub>I</sub> to 0.5V <sub>O</sub>		0.25	1	μs
I <sub>R</sub>	Clamp diode leakage current ( <a href="#">Figure 9</a> )	V <sub>R</sub> = 50V			50	μA
V <sub>F</sub>	Clamp diode forward voltage ( <a href="#">Figure 10</a> )	I <sub>F</sub> = 350mA		1.7	2	V

## 5 Test circuits

Figure 3. Output leakage current

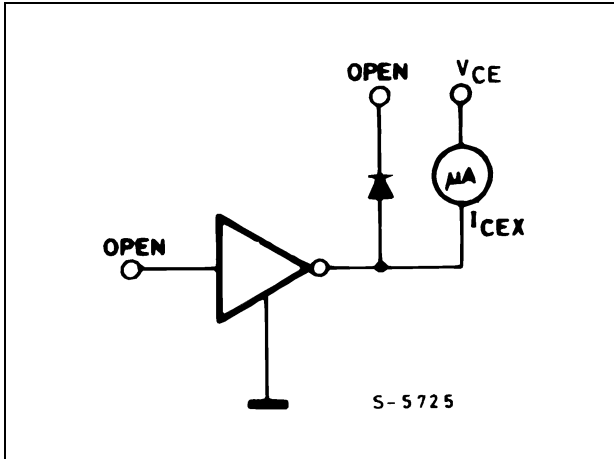


Figure 4. Output leakage current (for ULN2002 only)

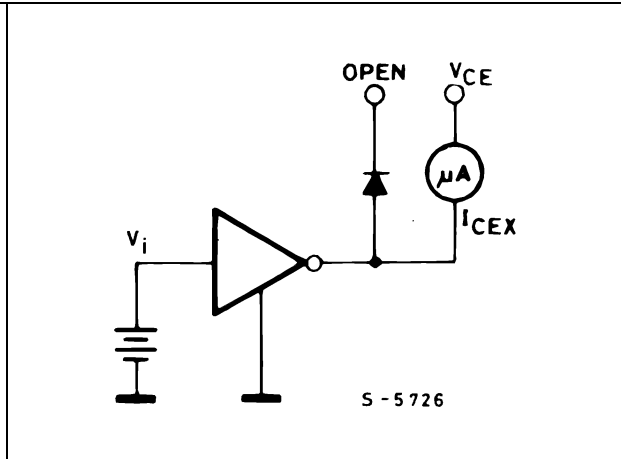


Figure 5. Collector-emitter saturation voltage Figure 6. Input current (ON)

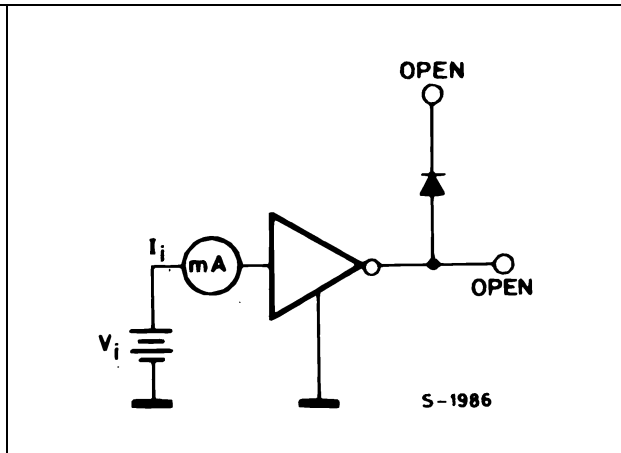
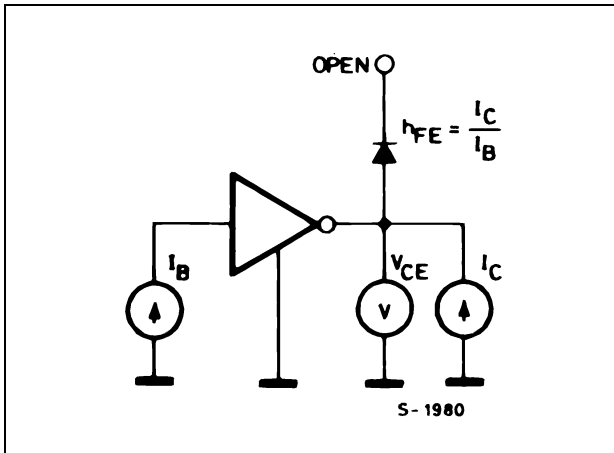


Figure 7. Input current (OFF)

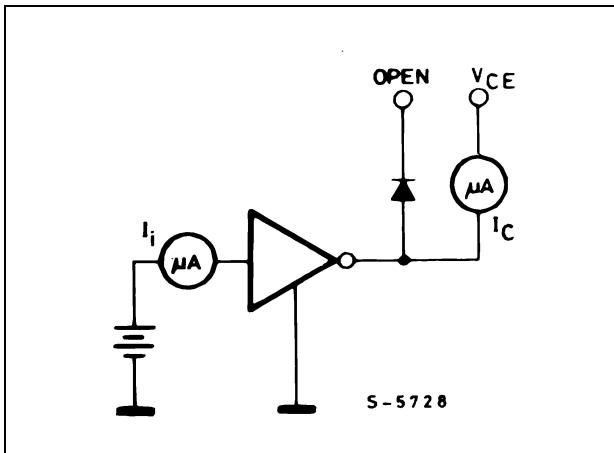


Figure 8. Input voltage

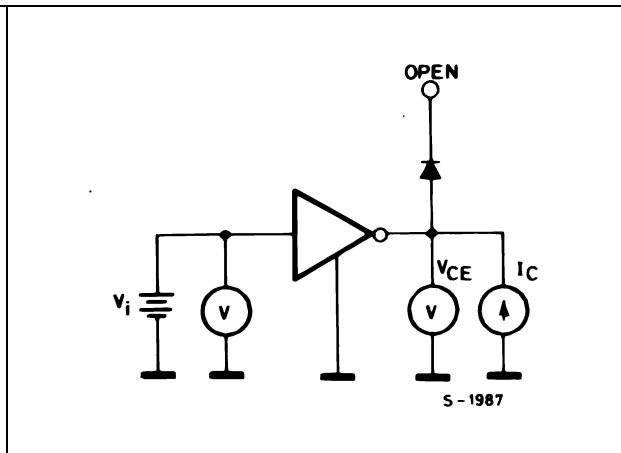


Figure 9. Clamp diode leakage current

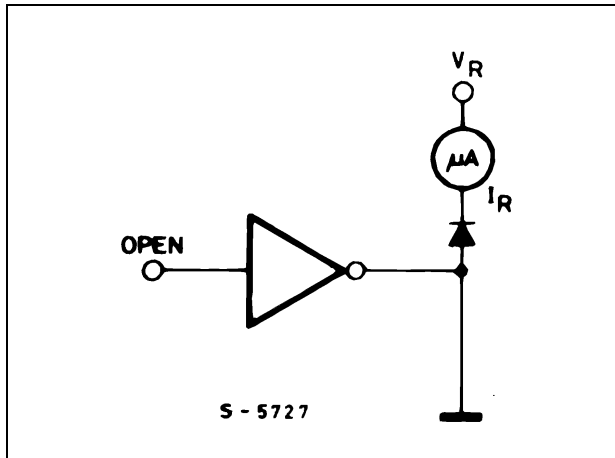
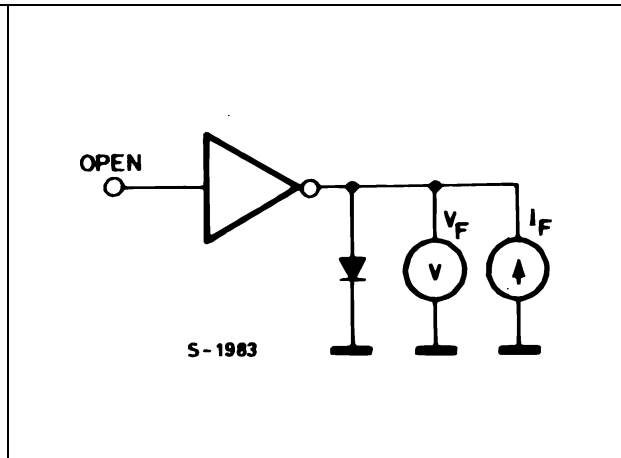


Figure 10. Clamp diode forward voltage



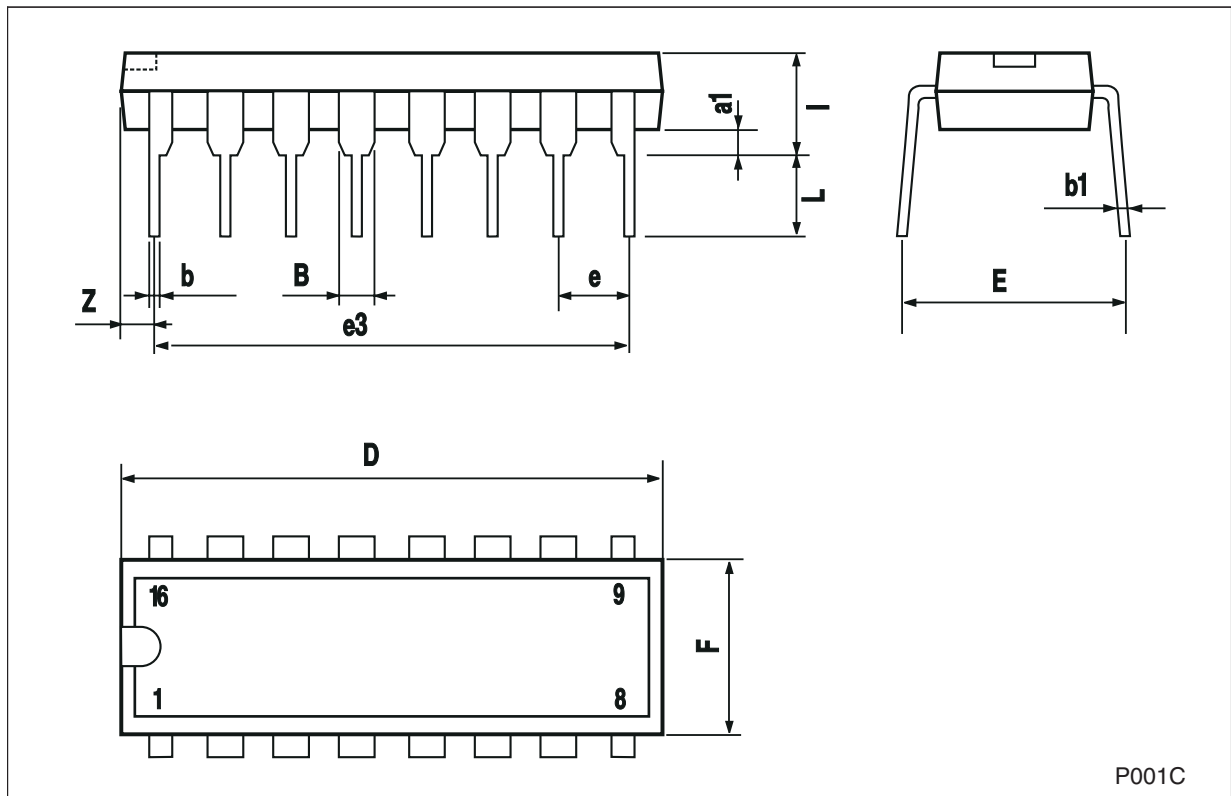


## 6 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

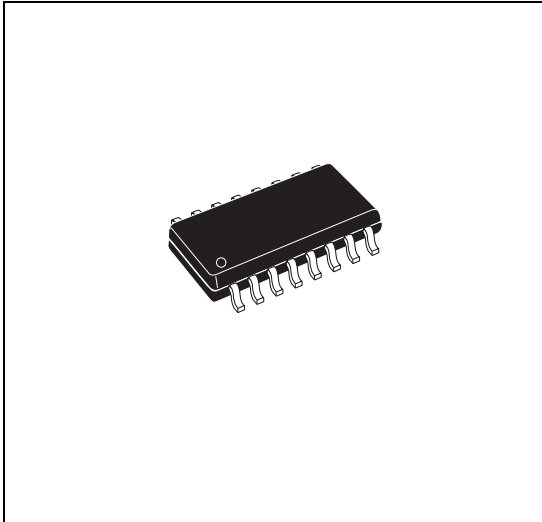
**Plastic DIP-16 (0.25) mechanical data**

Dim.	mm.			inch.		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050

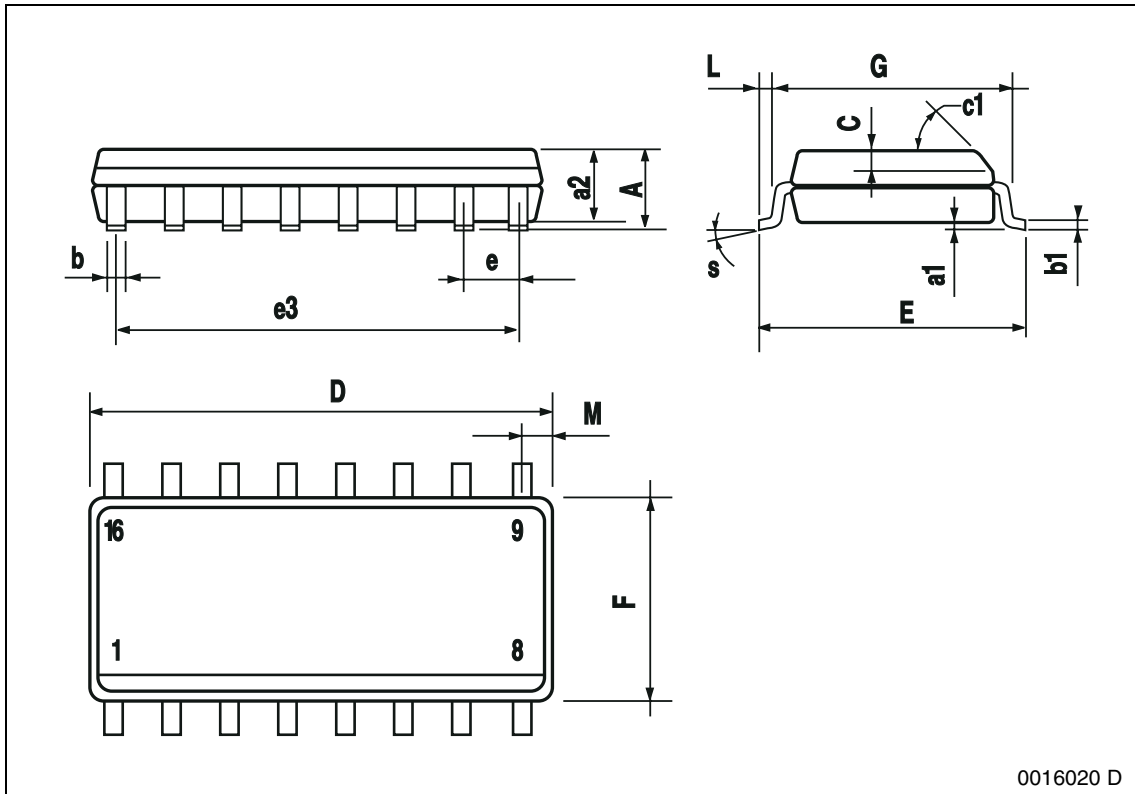


DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.069
a1	0.1		0.25	0.004		0.009
a2			1.6			0.063
b	0.35		0.46	0.014		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.020	
c1			45°	(typ.)		
D <sup>(1)</sup>	9.8		10	0.386		0.394
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F <sup>(1)</sup>	3.8		4.0	0.150		0.157
G	4.60		5.30	0.181		0.208
L	0.4		1.27	0.150		0.050
M			0.62			0.024
S	8° (max.)					
(1) "D" and "F" do not include mold flash or protrusions - Mold flash or protrusions shall not exceed 0.15mm (.006inc.)						

**OUTLINE AND MECHANICAL DATA**



**SO16 (Narrow)**



0016020 D

## 7 Revision history

**Table 6. Document revision history**

Date	Revision	Changes
05-Dec-2006	2	Order codes updated.
23-May-2007	3	Order codes updated.
17-Apr-2008	4	Added new order codes for Automotive grade products see <a href="#">Table 1 on page 1</a> .
25-Aug-2008	5	Modified: <a href="#">Table 4 on page 6</a> and <a href="#">Table 5 on page 7</a> .
11-Feb-2011	6	Modified: $T_J = -25$ to $105$ °C <a href="#">Table 4 on page 6</a> .

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